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(54) AIR CONDITIONING SYSTEM AND METHOD FOR CONTROLLING THE SAME

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(57) **ABSTRACT**

The present invention relates to air conditioning systems, and more particularly, to an air conditioning system which can control a refrigerant flow rate to a heat exchanger exchanging heat with room air to be optimum; and a method for controlling the same. The air conditioning system includes an outdoor heat exchange part including a compressor for compressing refrigerant, an outdoor heat exchanger for making the refrigerant to heat exchange with outdoor air, and an expansion device for expanding the refrigerant, an indoor heat exchange part including a pump for making refrigerant in a flow path independent from the outdoor heat exchange part to flow, at least one indoor heat exchanger for making the refrigerant heat exchange with room air, and a flow rate control device for controlling a flow rate of the refrigerant, and a hybrid heat exchange part for making the outdoor heat exchange part and the indoor heat exchange part, which are independent from each other, to heat exchange with each other. According to this, the air conditioning system can be installed on a multistory building without limitation of a height of the building as far as a capacity of the pump permits. Moreover, even if a refrigerant pipe is long, the air conditioning system is applicable even to a system with a refrigerant pipe line longer than the related art as far as the capacity of the pump permits, and fine control of a room air temperature is possible.

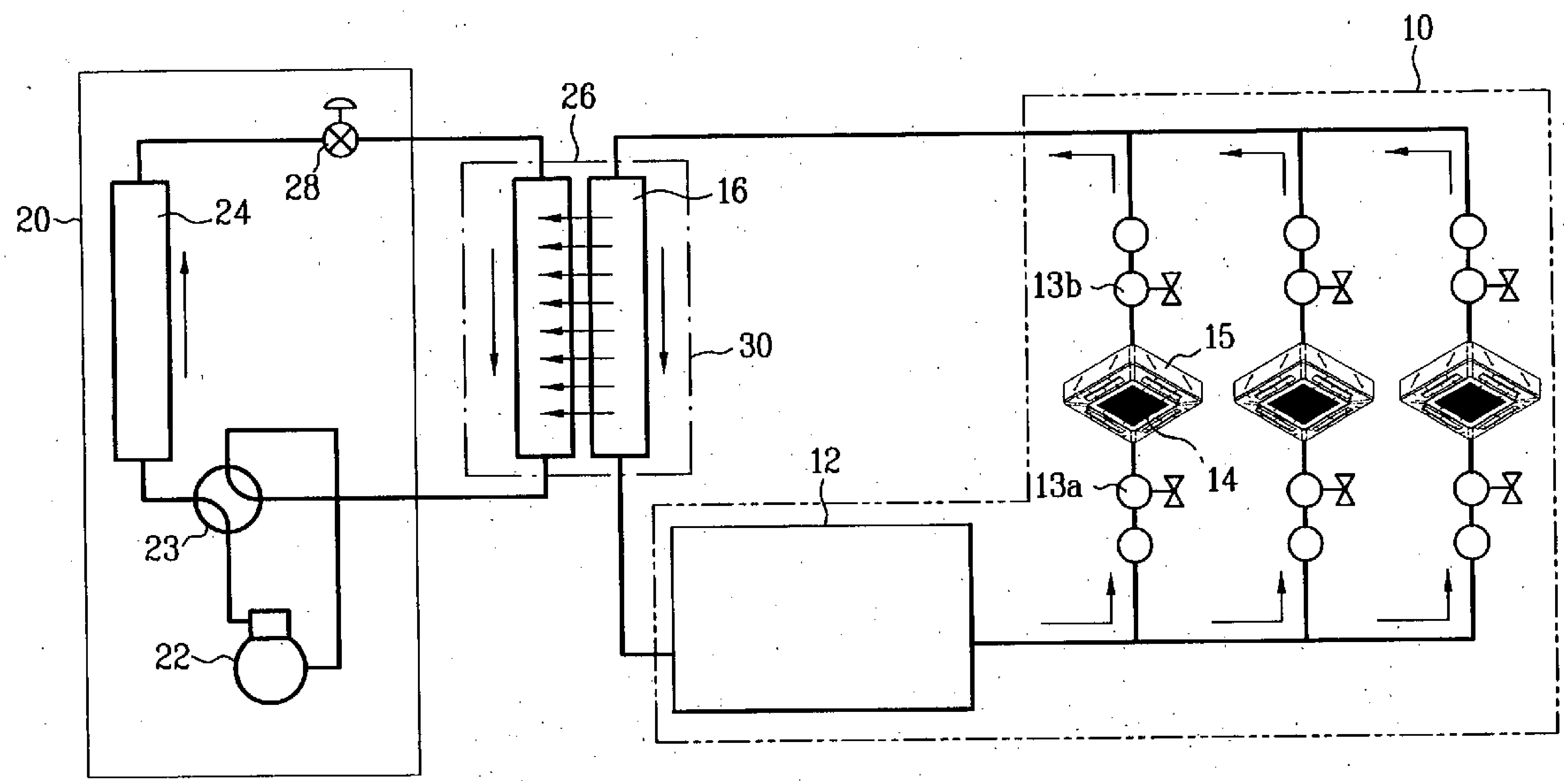


FIG. 1

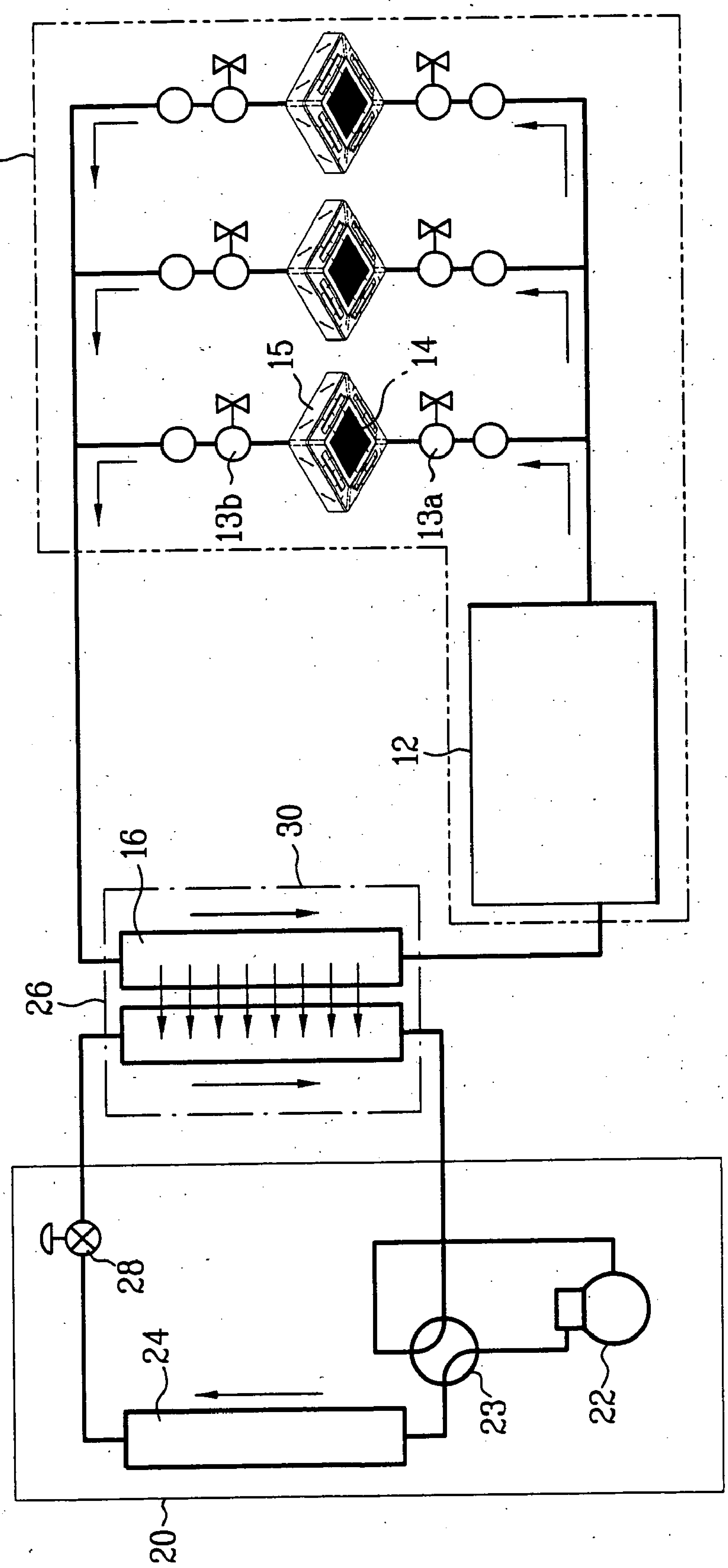


FIG. 2

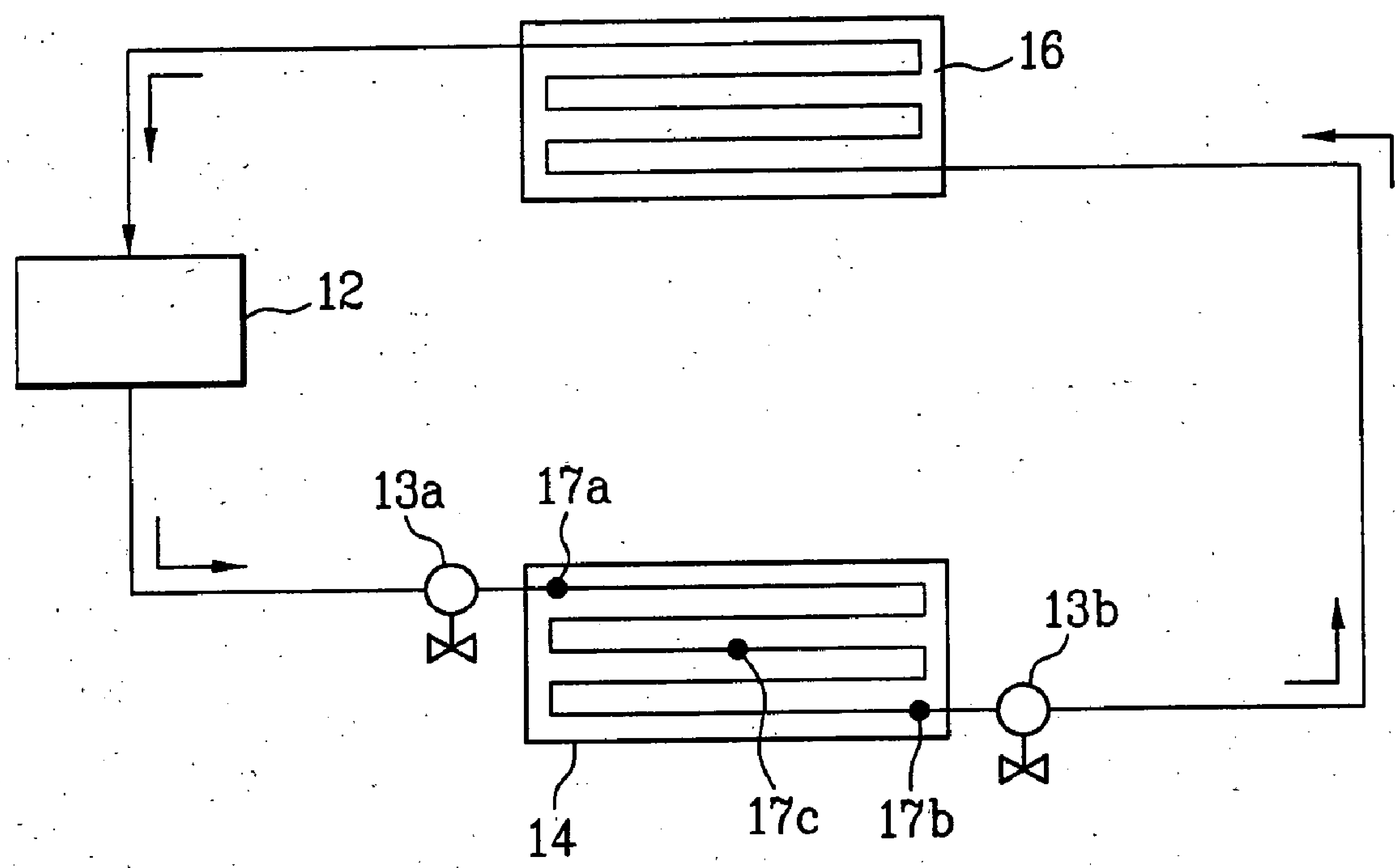


FIG. 3

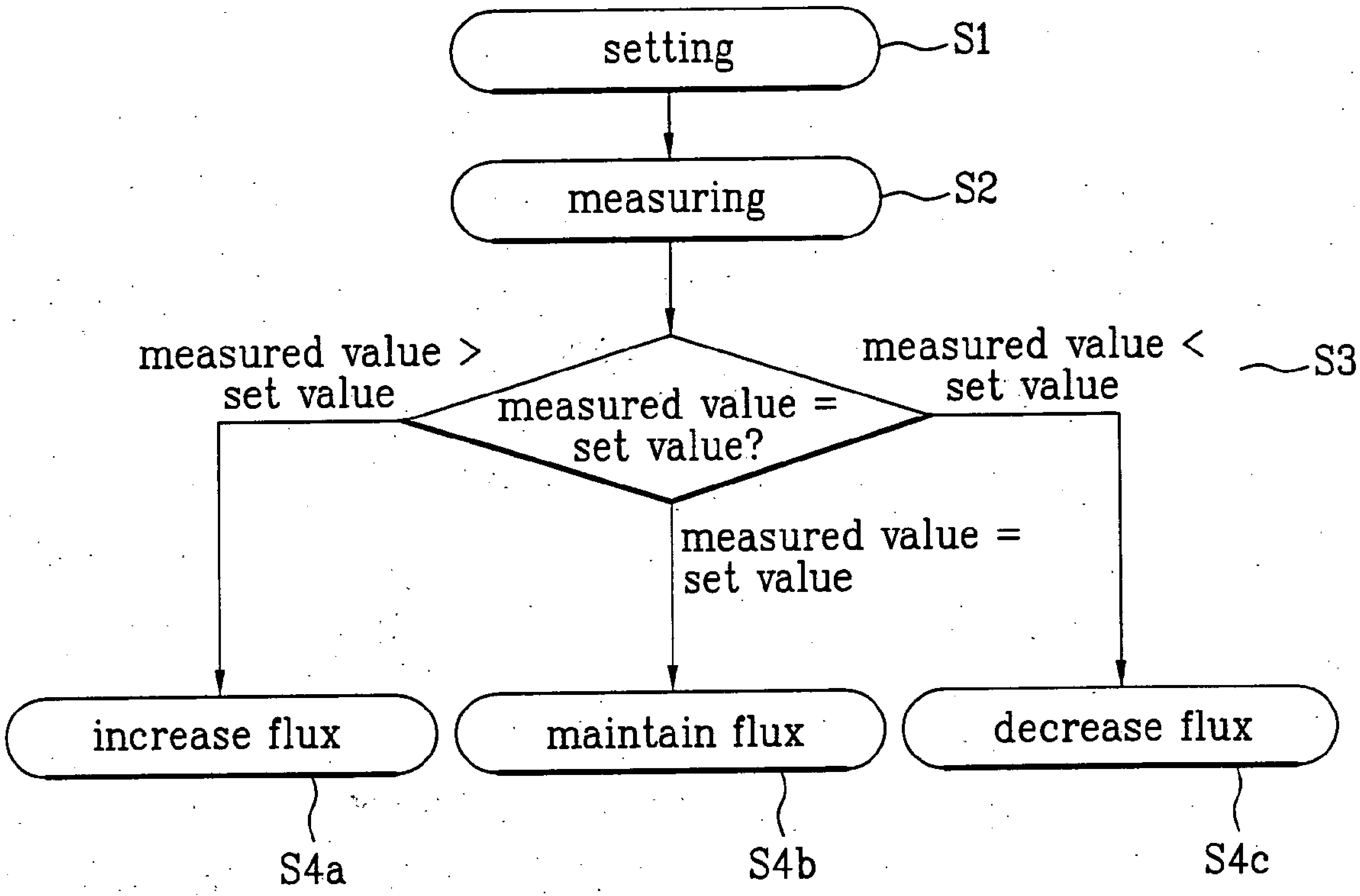

setting
S1
measuring
S2
measured value > set value
measured value = set value?
measured value < set value
S3
measured value = set value
increase flux
maintain flux
decrease flux
S4a
S4b
S4c

FIG. 4

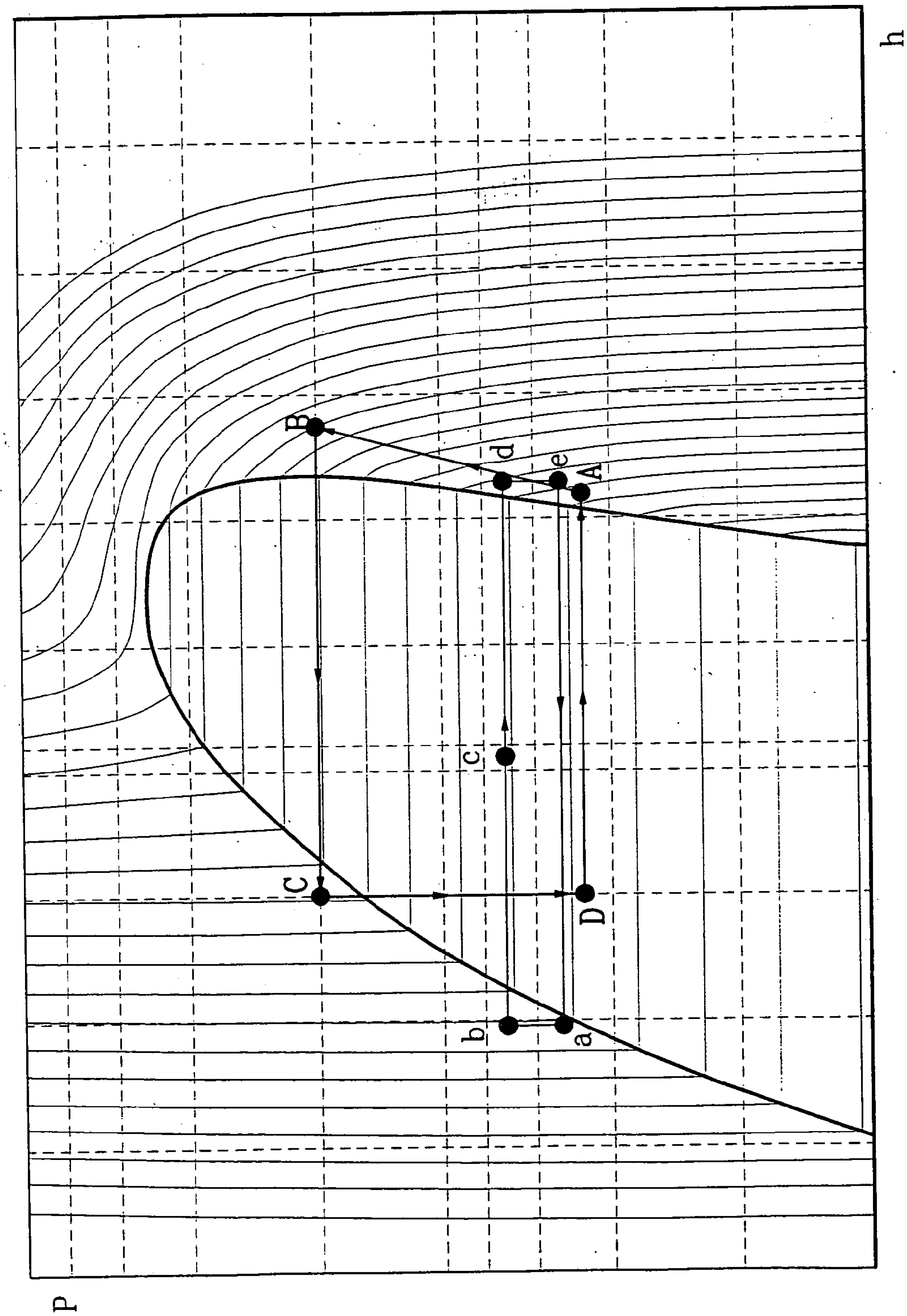
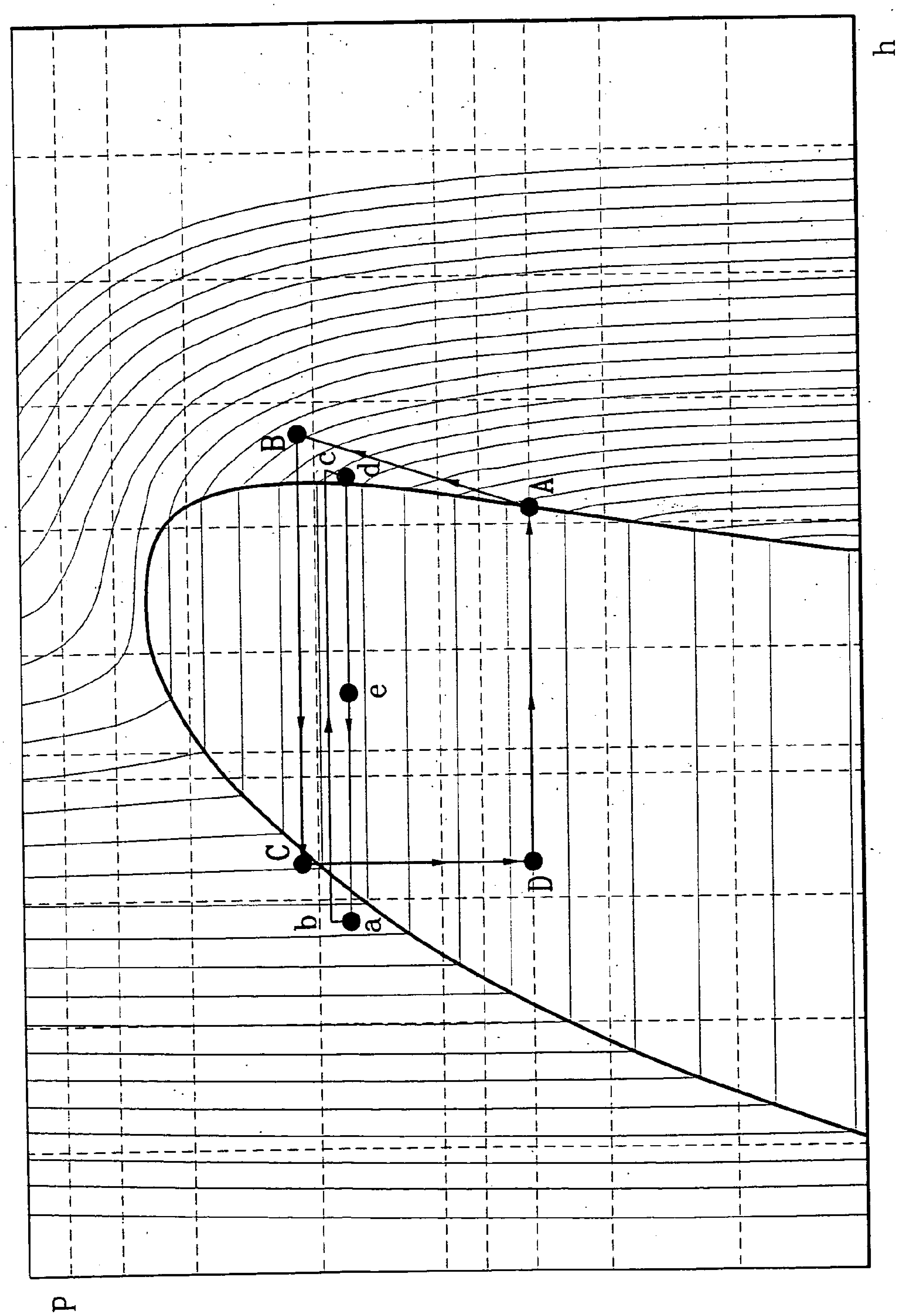


FIG. 5



AIR CONDITIONING SYSTEM AND METHOD FOR CONTROLLING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Application No. P2004-96315 filed on Nov. 23, 2004, which is hereby incorporated by reference as if fully set forth herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to air conditioning systems, and more particularly, to an air conditioning system which can control a refrigerant flow rate to a heat exchanger exchanging heat with room air to be optimum; and a method for controlling the same.

[0004] 2. Discussion of the Related Art

[0005] In general, the air conditioning system cools or heats a room by compressing, condensing, expanding, and evaporating refrigerant. In general, the air conditioning system is provided with a compressor, an indoor heat exchanger, an expansion device, and an outdoor heat exchanger.

[0006] In the air conditioning systems, there are a cooling system in which a refrigerating cycle is operated only in one direction, to supply only cold air to the room, and a heating/cooling system in which the refrigerating cycle is operated in two directions selectively, to supply cold air or warm air to the room.

[0007] Moreover, in the air conditioning systems, depending on a number of indoor units connected thereto, there are single air conditioning systems in each of which one indoor unit is connected to one outdoor unit, and multiple air conditioning systems in each of which a plurality of indoor units are connected to one outdoor unit.

[0008] The air conditioning system uses the compressor as a driving source for making the refrigerant to flow, and oil for lubricating the compressor.

[0009] However, if a height difference or a distance between the indoor heat exchanger, and the outdoor heat exchanger is great significantly, since the related art air conditioning system has a poor oil recovery rate, to fail in supply of an adequate rate of oil to the compressor, which is liable to result in damage to the compressor, development of an air conditioning system that can solve such a problem has been required.

SUMMARY OF THE INVENTION

[0010] Accordingly, the present invention is directed to an air conditioning system and a method for controlling the same that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0011] An object of the present invention is to provide a an air conditioning system and a method for controlling the same, which is applicable even to a case a height difference or a distance between an indoor heat exchanger, and an outdoor heat exchanger is great significantly.

[0012] Another object of the present invention is to provide an air conditioning system and a method for controlling the same, which enables a fine control of a room temperature.

[0013] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0014] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, an air conditioning system includes an outdoor heat exchange part including a compressor for compressing refrigerant, an outdoor heat exchanger for making the refrigerant to heat exchange with outdoor air, and an expansion device for expanding the refrigerant, an indoor heat exchange part including a pump for making refrigerant in a flow path independent from the outdoor heat exchange part to flow, a indoor heat exchanger for making the refrigerant heat exchange with room air, and a flow rate control device for controlling a flow rate of the refrigerant, and a hybrid heat exchange part for making the outdoor heat exchange part and the indoor heat exchange part, which are independent from each other, to heat exchange with each other.

[0015] The flow rate control device may include a temperature sensor for measuring temperatures of refrigerant flowing in the indoor heat exchanger, a controller for determining a degree of superheat or subcooling of the refrigerant with the temperatures measured at the temperature sensor, and a flow rate control valve for controlling a refrigerant flow rate to the indoor heat exchanger according to the determination of the controller.

[0016] The flow rate control valve may be mounted on a refrigerant inlet end of the indoor heat exchanger.

[0017] The flow rate control valve may be mounted on a refrigerant outlet end of the indoor heat exchanger.

[0018] The temperature sensors are mounted on the refrigerant inlet end, the refrigerant outlet end, and a predetermined portion between the refrigerant inlet end and the refrigerant outlet end of the indoor heat exchanger. Preferably, the predetermined portion between the refrigerant inlet end and the refrigerant outlet end of the indoor heat exchanger is a section in which the refrigerant flowing in the indoor heat exchanger is in a saturated state.

[0019] In the meantime, in another aspect of the present invention, a method for controlling an air conditioning system includes the steps of setting an ideal degree of superheat, and an ideal degree of subcooling at a controller, comparing the degree of superheat or subcooling set thus with a degree of superheat or subcooling measured thus, and controlling a flow rate of refrigerant flowing in an indoor heat exchanger according to a result of the step of comparing the degree of superheat or subcooling set thus with a degree of or subcooling measured thus.

[0020] The degree of superheat or subcooling is a difference between a temperature of the refrigerant at the refrigerant outlet of the indoor heat exchanger and a saturation temperature of the refrigerant flowing in the indoor heat exchanger.

[0021] The step of controlling a flow rate of refrigerant flowing in an indoor heat exchanger includes the steps of increasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of superheat measured is higher than the degree of superheat set, and decreasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of superheat measured is lower than the degree of superheat set.

[0022] The step of controlling a flow rate of refrigerant flowing in an indoor heat exchanger includes the steps of increasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of subcooling measured is higher than the degree of subcooling set, and decreasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of subcooling measured is lower than the degree of subcooling set.

[0023] In another aspect of the present invention, an air conditioning system includes at least one first heat exchanger for heat exchange with room air, a second heat exchanger for transferring heat from the first heat exchanger to an outside of a refrigerant flow path having the first heat exchanger mounted therein, a pump for circulating the refrigerant to the first heat exchanger and the second heat exchanger, a third heat exchanger in a flow path independent both from the first heat exchanger and the second heat exchanger for heat exchange with the second heat exchanger, a fourth heat exchanger for transferring heat from the third heat exchanger to outdoor air, a compressor for compressing the refrigerant and circulating the refrigerant to the third heat exchanger and the fourth heat exchanger, a plurality of temperature sensors for measuring temperatures of the refrigerant flowing in the first heat exchanger, at least one flow rate control valve for controlling a flow rate of the refrigerant flowing in the first heat exchanger according to temperatures measured at the temperature sensors.

[0024] The temperature sensors are provided at a refrigerant inlet end and a refrigerant outlet end of the first heat exchanger, and at a predetermined portion between the refrigerant inlet end and the refrigerant outlet end, respectively. The temperature sensor provided at a predetermined portion between the refrigerant inlet end and the refrigerant outlet end measures a saturation temperature of the refrigerant flowing in the first heat exchanger.

[0025] The flow rate control valves are provided to a refrigerant inlet end and a refrigerant outlet end of the indoor heat exchanger. At the time of controlling a refrigerant flow rate, an opening of the flow rate control valve at the refrigerant inlet end of the first heat exchanger is adjusted, and an opening of the flow rate control valve at the refrigerant outlet end is opened to the maximum.

[0026] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings;

[0028] **FIG. 1** illustrates a diagram of an air conditioning system in accordance with a preferred embodiment of the present invention, schematically;

[0029] **FIG. 2** illustrates a diagram of an indoor heat exchange part in the air conditioning system in **FIG. 1**, schematically;

[0030] **FIG. 3** illustrates a flow chart showing the steps of a method for controlling an air conditioning system in accordance with a preferred embodiment of the present invention;

[0031] **FIG. 4** illustrates a P-h diagram showing a state change of refrigerant in cooling operation of the air conditioning system in **FIG. 1**; and

[0032] **FIG. 5** illustrates a P-h diagram showing a state change of refrigerant in heating operation of the air conditioning system in **FIG. 1**.

DETAILED DESCRIPTION OF THE INVENTION

[0033] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0034] **FIGS. 1 and 2** illustrate diagrams each showing an air conditioning system in accordance with a preferred embodiment of the present invention.

[0035] Referring to **FIGS. 1 and 2**, the air conditioning system includes an indoor heat exchange part **10** for heat exchange with room air, an outdoor heat exchange part **20** for heat exchange with outdoor air, and a hybrid heat exchanger **30** for making refrigerant in the indoor heat exchange part **10** and refrigerant in the outdoor heat exchange part **20** to heat exchange with each other.

[0036] The indoor heat exchange part **10** includes a first heat exchanger **14** for heat exchange with the room air, a pump **12** for circulating the refrigerant to the first heat exchanger **14**, and a flow rate control device for controlling a flow rate of the refrigerant to the first heat exchanger **14**.

[0037] The outdoor heat exchange part **20** has a refrigerant flow path independent from the indoor heat exchange part **10**, and includes a fourth heat exchanger **24** for making the refrigerant to heat exchange with outdoor air, and a compressor **22** for compressing, and circulating the refrigerant to the fourth heat exchanger **24**.

[0038] The outdoor heat exchange part **20** includes an expansion device **28** for expanding the refrigerant to drop a pressure of the refrigerant, and a flow controller **23** for controlling a flow direction of the refrigerant, additionally.

[0039] In the meantime, the outdoor heat exchange part **20** may have many variations as far as the part can transfer heat to the refrigerant in the indoor heat exchange part **10**. As an example, the part may use warm water or waste heat as a heat source.

[0040] The hybrid heat exchange part **30** is configured such that the indoor heat exchange part **10** and the outdoor heat exchange part **20** having refrigerant flow paths independent from each other can heat exchange with each other, without mix of the refrigerant between the indoor heat exchange part **10** and the outdoor heat exchange part **20**.

[0041] In order to enable the indoor heat exchanger **10** and the outdoor heat exchanger **20** make heat exchange with each other, the hybrid heat exchange part **30** includes a second heat exchanger **16** in a flow path of the indoor heat exchange part **10**, and a third heat exchanger **26** in a flow path of the outdoor heat exchange part **20** for heat exchange with the second heat exchanger **16**.

[0042] That is, the second heat exchanger **16** exchanges heat with the third heat exchanger **26** so that the indoor heat exchange part **10** and the outdoor heat exchange part **20** make heat exchange.

[0043] Moreover, the second heat exchanger **16** forms a refrigerant circulating flow path as a portion of the indoor heat exchange part **10**, and the third heat exchanger **26** forms a refrigerant circulating flow path as a portion of the outdoor heat exchange part **20**.

[0044] That is, the outdoor heat exchange part **20** forms a refrigerant flow path with the third heat exchanger **26**, the fourth heat exchanger **24**, the compressor **22**, and the expansion device **28**, and the indoor heat exchange part **10** forms a refrigerant flow path with the first heat exchanger **14**, the second heat exchanger **16**, the pump **12**, and a flow rate control device.

[0045] The second heat exchanger **16** and the third heat exchanger **26** may have many variations. That is, the second heat exchanger **16** and the third heat exchanger **26** may be constructed of heat dissipation plates, or refrigerant tubes.

[0046] The hybrid heat exchange part **30** is configured to enable the second heat exchanger **16**, and the third heat exchanger **26** in the outdoor heat exchange part to make thermal contact with each other.

[0047] For an example, the hybrid heat exchange part **30** may be constructed of a stack of a plurality of plate type heat conductive fins having the second heat exchanger **16** and the third heat exchanger **26** placed therebetween so as to be thermally in contact with each other.

[0048] Or alternatively, the hybrid heat exchange part **30** may has a structure in which the second heat exchanger and the third heat exchanger heat exchange with each other through a heat conductive fluid. Or, the second heat exchanger **16** and the third heat exchanger **26** are configured to have a form of a double tube.

[0049] In the meantime, the indoor heat exchange part **10** will be described in more detail.

[0050] As described before, the indoor heat exchange part **10** has a flow path independent from the outdoor heat exchange part **20**, and includes a first heat exchanger **14**, a pump **12**, a flow rate control device, and a second heat exchanger **16** of the hybrid heat exchange part **30**.

[0051] The indoor heat exchange part **10** has a pump **12** instead of a compressor as a driving source for making the refrigerant to flow, and has no separate expansion device for expanding the refrigerant. Owing to this, the indoor heat exchange part **10** requires no oil for operation of the compressor, and consequently, no operation for recovery of the refrigerant is required.

[0052] It is preferable that the pump **12** includes a pumping motor (not shown) and an impeller (not shown). Moreover, it is preferable that liquid refrigerant is supplied to the pump **12**, for which, though not shown, a separate refrigerant storage tank may be provided between the hybrid heat exchange part **30** and the pump **12**, for supplying refrigerant to the pump **12**.

[0053] It is preferable that an inverter motor is employed as the pumping motor for controlling a rotation speed of the motor, to control a flow rate of the refrigerant. Of course, a constant speed motor having a constant rotation speed may be used.

[0054] In general, the first heat exchanger **14** is mounted in an indoor unit **15** installed in a room which requires cooling/heating. That is, the first heat exchanger **14** is an indoor heat exchanger for heat exchange with room air to cool or heat the room.

[0055] There may be a plurality of indoor units **15** installed in a room if required, and according to this, a plurality of indoor heat exchangers **14** may be mounted thereon.

[0056] The flow rate control device includes a plurality of temperature sensors **17***a*, **17***b*, and **17***c* for measuring temperatures of the refrigerant flowing through the indoor heat exchanger **14**, a controller (not shown) for determining a degree of superheat or subcooling of the refrigerant in the indoor heat exchanger **14** with reference to the temperatures measured at the temperature sensors **17***a*, **17***b*, and **17***c*, and flow rate control valves **13***a*, and **13***b* for controlling a flow rate of the refrigerant to the indoor heat exchanger **14** according to the determination of the controller.

[0057] It is preferable that the flow rate control valve **13***a*, and **13***b* are solenoid valves each for controlling an opening of a flow passage with an electromagnetic force. Of course, there can be a variety of the flow rate control valves **13***a*, and **13***b* as far as the valve can control the opening of the flow passage.

[0058] Moreover, though it is preferable that the flow rate control valve **13***a*, and **13***b* are mounted on opposite ends of the indoor heat exchanger **14** into which the refrigerant flows in/out, the mounting positions of the flow rate control valve **13***a*, and **13***b* are not limited to this, but the flow rate control valve **13***a*, and **13***b* may be mounted only one of the opposite ends.

[0059] Mounting positions of the temperature sensors will be described with reference to **FIG. 2**.

[0060] It is preferable that the temperature sensors **17***a*, **17***b*, and **17***c* are mounted on an inlet **17***a* through which the refrigerant is introduced into the indoor heat exchanger **14**, an outlet **17***b* through which the refrigerant is discharged from the indoor heat exchanger **14**, and a predetermined portion **17***c* between the inlet **17***a*, and the outlet **17***b*, respectively.

[0061] That is, at least three temperature sensors **17***a*, **17***b*, and **17***c* are mounted on every indoor heat exchanger **14** mounted on the indoor unit **15**.

[0062] Of the three temperature sensors **17***a*, **17***b*, and **17***c*, it is preferable that the temperature sensor **17***c* mounted on the predetermined portion between the inlet **17***a*, and the outlet **17***b* is mounted on one point where refrigerant in the indoor heat exchanger **14** is in a saturated state, so that the temperature sensor **17***c* can measure a temperature at a saturated state of the refrigerant.

[0063] The temperature at a saturated state is a temperature when there is no temperature change even if a phase of the refrigerant changes following heat exchange of the refrigerant.

[0064] The controller has an ideal degree of superheat and an ideal degree of subcooling preset thereto at a pressure of the refrigerant, and an actual degree of superheat and an actual degree of subcooling are calculated with temperatures measured at respective portions of the indoor heat exchanger **14** with the temperature sensors **17***a*, **17***b*, and **17***c*.

[0065] The degrees of superheat or subcooling is a temperature difference measured between the temperature sensor **17***b* at the outlet and the temperature sensor **17***c* at the middle of the indoor heat exchanger **14**.

[0066] The degree of superheat is a temperature difference at the time of cooling, and the degree of subcooling is a temperature difference at the time of heating.

[0067] A method for controlling a flow rate of refrigerant with reference to the degree of superheat or subcooling in the air conditioning system will be described.

[0068] **FIG. 3** illustrates a flow chart showing the steps of a method for controlling an air conditioning system in accordance with a preferred embodiment of the present invention.

[0069] Referring to **FIG. 3**, the method for controlling an air conditioning system includes the steps of setting an ideal degree of subcooling and an ideal degree of superheat at a controller (S**1**), measuring the degree of subcooling or superheat of the refrigerant flowing in an indoor heat exchanger (S**2**), comparing the degree of subcooling or superheat set thus to the degree of subcooling or superheat measured (S**3**), and controlling a flow rate of the refrigerant flowing in the indoor heat exchanger according to a result in the step S**3** in which the degree of subcooling or superheat set thus is compared to the degree of subcooling or superheat measured.

[0070] As described, the degree of superheat or the degree of subcooling is a difference between a temperature of the refrigerant at the outlet of the indoor heat exchanger **14**, and a temperature of the refrigerant at a saturation state of the refrigerant flowing in the indoor heat exchanger **14**.

[0071] Moreover, as described, the temperatures of the refrigerant are measured with a plurality of temperature sensors **17***a*, **17***b*, and **17***c* mounted on the indoor heat exchanger **14**.

[0072] At first, a setting step (S**1**) is performed, in which an ideal degree of superheat and an ideal degree of subcooling at the time of operation of the indoor heat exchanger are set at the controller. The ideal degree of superheat and the ideal degree of subcooling vary with a pressure of the refrigerant and an environmental temperature.

[0073] Then, a measuring step (S**2**) is performed, in which an actual degree of superheat or an actual degree of subcooling of the refrigerant flowing in the indoor heat exchanger **14** is measured. In the measuring step (S**2**), the temperatures of the refrigerant are measured with the temperature sensors **17***a*, **17***b*, and **17***c* mounted on the indoor heat exchanger **14**.

[0074] That is, since the degree of superheat or the degree of subcooling is a difference of a temperature of the refrigerant at the outlet of the indoor heat exchanger **14** and a saturation temperature of the refrigerant flowing in the indoor heat exchanger, the controller can calculate the degree of superheat or the degree of subcooling with the temperatures measured at the temperature sensors **17***a*, **17***b*, and **17***c*.

[0075] Then, a determination step (S**3**) is performed, in which a measured degree of superheat or subcooling is compared to a preset degree of superheat or subcooling. In the determination step (S**3**), it is determined whether the measured degree of superheat or subcooling converges to the preset degree of superheat or subcooling, or not, or if not, which one has how much difference.

[0076] Then, an adjusting step (S**4**) is performed, in which a flow rate of the refrigerant flowing in the indoor heat exchanger **14** is adjusted according to a result of determination in the determination step (S**3**).

[0077] In the adjusting step (S**4**), the flow rate of the refrigerant is adjusted by controlling the flow rate control valve **13***a*, and **13***b* at opposite ends of the indoor heat exchange part **10**.

[0078] In more detail, if the degree of superheat measured is higher than the preset degree of superheat at the time of room cooling, opening of the flow rate control valves **13***a*, and **13***b* are adjusted, to increase a flow rate of the refrigerant flowing in the indoor heat exchanger **14** (S**4***a*), and if the degree of superheat measured is lower than the preset degree of superheat at the time of room cooling, opening of the flow rate control valves **13***a*, and **13***b* are adjusted, to decrease a flow rate of the refrigerant flowing in the indoor heat exchanger **14** (S**4***c*).

[0079] If the degree of superheat measured is the same with the preset degree of superheat the time of room cooling, the flow rate of the refrigerant flowing in the indoor heat exchanger **14** is maintained (S(S**4***b*).

[0080] In the meantime, if the degree of subcooling measured is higher than the preset degree of subcooling at the time of room heating, opening of the flow rate control valves **13***a*, and **13***b* are adjusted, to increase a flow rate of the refrigerant flowing in the indoor heat exchanger **14** (S**4***a*), and if the degree of subcooling measured is lower than the preset degree of subcooling at the time of room cooling, opening of the flow rate control valves **13***a*, and **13***b* are adjusted, to decrease a flow rate of the refrigerant flowing in the indoor heat exchanger **14** (S**4***c*).

[0081] If the degree of superheat measured is the same with the preset degree of superheat the time of room cooling, the flow rate of the refrigerant flowing in the indoor heat exchanger **14** is maintained (S(S**4***b*).

[0082] The operation of the air conditioning system will be described.

[0083] **FIGS. 4 and 5** illustrate graphs showing variations of a pressure 'P' and enthalpy 'h' of refrigerant at the outdoor heat exchange part **20** and the indoor heat exchange part **10** at the time of room cooling and room heating of the air conditioning system, respectively.

[0084] The air conditioning system cools or heats the room depending on an operation.

[0085] At the time of cooling or heating, the hybrid heat exchange part **30** exchanges heat between the outdoor heat exchange part **20** and the indoor heat exchange part **10**.

[0086] The cooling operation will be described with reference to **FIGS. 1 and 2**.

[0087] The refrigerant in the outdoor heat exchange part **20** is compressed at the compressor **22**, and forwarded to the flow controller **23** (A-B section). The flow controller **23** changes over the refrigerant to a side of the fourth heat exchanger **24**. In this instance, the refrigerant introduced to the fourth heat exchanger **24** is condensed as the refrigerant heat exchanges with outdoor air (B-C section). The condensed refrigerant changes to a refrigerant of a low temperature and low pressure as the refrigerant passes through the expansion device **28** (C-D section). After cooling down the third heat exchanger **26** of the hybrid heat exchange part **30**, the low temperature and low pressure refrigerant is introduced into the compressor **22** through the flow controller **23** (D-A section). In the outdoor heat exchange part **20**, the compressor **22** serves as a driving source if the refrigerant flow.

[0088] Then, the refrigerant in the indoor heat exchange part **10** is cooled down as the second heat exchanger **16** and the third heat exchanger **26** in the hybrid heat exchange part **30** exchange heat (e-a section). The refrigerant cooled down thus is pumped to a side of the first heat exchanger by the pump **12** (a-b section). In this instance, the refrigerant is neither in a two phase state, nor at a saturated temperature. The pumped refrigerant is introduced to the first heat exchanger **14** through the flow rate control valves **13***a*, and **13***b* at an inlet of the first heat exchanger **14**, and discharged from the first heat exchanger **14** after heat exchanger with room air (b-c-d section).

[0089] The refrigerant in the indoor heat exchange part **10** reaches to a saturation temperature at which the refrigerant is involved no temperature change, but a phase change as the refrigerant heat exchanges with room air (c point). In this step, the temperature sensor **17***c* between opposite ends of the first heat exchanger **14** measures a saturation temperature of the refrigerant, and the temperature sensor **17***b* at the outlet of the first heat exchanger **14** (corresponding to 'd' point) measures a superheated temperature of the refrigerant.

[0090] According to this, the controller determines a difference between the saturation temperature and the superheated temperature, to derive the degree of superheat, compares the derived degree of superheat to the preset degree of superheat of the refrigerant, and adjusts opening of the flow rate control valves **13***a*, and **13***b*.

[0091] That is, if it is determined that the measured degree of superheat is higher than the preset degree of superheat, opening of the flow rate control valves **13***a*, and **13***b* on the first heat exchanger **14** is made greater, to increase a flow rate of the refrigerant.

[0092] Opposite to this, if it is determined that the measured degree of superheat is lower than the preset degree of superheat, opening of the flow rate control valves **13***a*, and **13***b* on the first heat exchanger **14** is made smaller, to decrease a flow rate of the refrigerant.

[0093] In this instance, of the flow rate control valves **13***a*, and **13***b* on opposite ends of the first heat exchanger **14**, though it is preferable that opening of the flow rate control valve **13***a* at an inlet end of the first heat exchanger **14** is made greater or smaller, and opening of the flow rate control valve **13***b* at an outlet end of the first heat exchanger **14** is opened to the maximum, the way of opening of the flow rate control valves **13***a*, and **13***b* is not limited to this one.

[0094] According to this, the flow rate of the refrigerant to the first heat exchanger **14** can be controlled to the optimum.

[0095] After making heat exchange at the first heat exchanger **14**, the refrigerant is discharged from the first heat exchanger **14** to the second heat exchanger **16** of the hybrid heat exchange part **30**, and cooled therein again, to circulate therefrom.

[0096] Next, heating operation will be described with reference to **FIGS. 1, 2**, and **5**.

[0097] After compressed at the compressor **22** in the outdoor heat exchange part **20**, the refrigerant is forwarded to the flow controller **23** (A-B). The flow controller **23** changes over the refrigerant to a side of the third heat exchanger **26** of the hybrid heat exchange part **30**. In this instance, the refrigerant introduced into the hybrid heat exchange part **30** discharges heat, and condensed at the third heat exchanger **26** (B-C). The condensed refrigerant is changed to refrigerant of a low pressure and a low temperature as the refrigerant passes through the expansion device **28** (C-D), introduced into the fourth heat exchanger **24**, heat exchanges with outdoor air, and is introduced into the compressor through the flow controller **23** (D-A). A circulation direction of the refrigerant in the outdoor heat exchange part **20** is opposite to the cooling operation.

[0098] Then, the refrigerant at the indoor heat exchange part **10** has a pressure boosted by pumping of the pump **12** (a-b). The pumped refrigerant is heated as the refrigerant heat exchanges at the second heat exchanger **16** of the hybrid heat exchange part **30** with the third heat exchanger **26** of the outdoor heat exchange part **20** (b-c).

[0099] The refrigerant heated thus is forwarded to a side of the first heat exchanger **14** by the pump **12**. The refrigerant introduced into the first heat exchanger **14** heat exchanges with room air to heat the room, while the refrigerant itself is condensed (c-a).

[0100] In this instance, as the refrigerant in the first heat exchanger **14** heat exchanges with the room air, the refrigerant reaches to a saturation temperature at which the refrigerant is involved in no temperature change, but a phase change (d-e). In such a step, the temperature sensor **17***c* between the refrigerant inlet/outlet of the first heat exchanger **14** measures the saturation temperature of the refrigerant ('e' point), and the temperature sensor **17***b* at the outlet of the first heat exchanger **14** measures a superheated temperature of the refrigerant ('a' point).

[0101] According to this, the controller derives the degree of superheat as a difference between the saturation temperature and the superheated temperature, compares the derived degree of superheat to the preset degree of superheat of the refrigerant, and adjusts opening of the flow rate control valves **13***a*, and **13***b*.

[**0102**] That is, if it is determined that the measured degree of superheat is higher than the preset degree of superheat, opening of the flow rate control valves **13***a* on the refrigerant inlet of the first heat exchanger **14** is made greater, to increase the flow rate of the refrigerant to the first heat exchanger **14**.

[**0103**] Opposite to this, if it is determined that the measured degree of superheat is lower than the preset degree of superheat, opening of the flow rate control valves **13***a* is made smaller, to decrease a flow rate of the refrigerant. According to this, the flow rate to the first heat exchanger **14** is adjusted.

[**0104**] The refrigerant having room air heat exchanged therewith at the first heat exchanger **14** makes circulation in which the refrigerant is introduced into, and heated again at the second heat exchanger **16** of the hybrid heat exchange part **30**.

[**0105**] As has been described, the air conditioning system and the method for controlling the same of the present invention have the following advantages.

[**0106**] The supply of refrigerant to the indoor heat exchange part by using a pump as a driving source that requires no oil permits to dispense with an oil recovery operation at the indoor heat exchange part.

[**0107**] According to this, the air conditioning system can be installed on a multistory building without limitation of a height of the building as far as a capacity of the pump permits. Moreover, even if a refrigerant pipe is long, the air conditioning system is applicable even to a system with a refrigerant pipe line longer than the related art as far as the capacity of the pump permits.

[**0108**] Moreover, the compressor and the expansion device of the outdoor heat exchange part may be placed outside of a room mounted on the outdoor unit. Therefore, even if the compressor and the expansion device generate noise, the noise can not reach to the user.

[**0109**] Furthermore, since the outdoor heat exchange part is connected to the indoor heat exchange part through the hybrid heat exchange part, a length of the refrigerant pipeline of the outdoor heat exchange part can be shortened significantly regardless of a height of the building. According to this, a refrigerant recovery ratio can be improved significantly, to prevent the compressor suffering from damage caused by a poor refrigerant recovery ratio.

[**0110**] Since the saturation temperature of the refrigerant can be measured at the first heat exchanger in the indoor heat exchange part, control of the refrigerant flow rate to the first heat exchanger can be optimized.

[**0111**] The optimum control of the refrigerant flow rate from the first heat exchanger permits fine control of the room temperature.

[**0112**] The no provision of the compressor and the expansion device to the indoor heat exchange part to be installed in a room permits simple structure of the indoor heat exchange part, which enables to reduce price of the indoor unit.

[**0113**] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An air conditioning system comprising:

an outdoor heat exchange part including a compressor for compressing refrigerant, an outdoor heat exchanger for making the refrigerant to heat exchange with outdoor air, and an expansion device for expanding the refrigerant;

an indoor heat exchange part including a pump for making refrigerant in a flow path independent from the outdoor heat exchange part to flow, an indoor heat exchanger for making the refrigerant heat exchange with room air, and a flow rate control device for controlling a flow rate of the refrigerant; and

a hybrid heat exchange part for making the outdoor heat exchange part and the indoor heat exchange part, which are independent from each other, to heat exchange with each other.

2. The system as claimed in claim 1, wherein the flow rate control device includes;

a temperature sensor for measuring temperatures of refrigerant flowing in the indoor heat exchanger,

a controller for determining a degree of superheat or subcooling of the refrigerant with the temperatures measured at the temperature sensors, and

a flow rate control valve for controlling a refrigerant flow rate to the indoor heat exchanger according to the determination of the controller.

3. The system as claimed in claim 2, wherein the flow rate control valve is mounted on a refrigerant inlet end of the indoor heat exchanger.

4. The system as claimed in claim 2, wherein the flow rate control valve is mounted on a refrigerant outlet end of the indoor heat exchanger.

5. The system as claimed in claim 2, wherein the temperature sensors are mounted on the refrigerant inlet end, the refrigerant outlet end, and a predetermined portion between the refrigerant inlet end and the refrigerant outlet end of the indoor heat exchanger.

6. The system as claimed in claim 5, wherein the predetermined portion between the refrigerant inlet end and the refrigerant outlet end of the indoor heat exchanger is a section in which the refrigerant flowing in the indoor heat exchanger is in a saturated state.

7. A method for controlling an air conditioning system comprising the steps of:

setting an ideal degree of superheat, and an ideal degree of subcooling at a controller;

comparing the degree of superheat or subcooling set thus with a degree of superheat or subcooling measured thus; and

controlling a flow rate of refrigerant flowing in an indoor heat exchanger according to a result of the step of comparing the degree of superheat or subcooling set thus with a degree of superheat or subcooling measured thus.

8. The method as claimed in claim 7, wherein the degree of superheat or subcooling is a difference between a temperature of the refrigerant at the refrigerant outlet of the indoor heat exchanger and a saturation temperature of the refrigerant flowing in the indoor heat exchanger.

9. The method as claimed in claim 7, wherein the step of controlling a flow rate of refrigerant flowing in an indoor heat exchanger includes the steps of;

increasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of superheat measured is higher than the degree of superheat set, and

decreasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of superheat measured is lower than the degree of superheat set.

10. The method as claimed in claim 7, wherein the step of controlling a flow rate of refrigerant flowing in an indoor heat exchanger includes the steps of;

increasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of subcooling measured is higher than the degree of subcooling set, and

decreasing the flow rate of the refrigerant flowing in the indoor heat exchanger if the degree of subcooling measured is lower than the degree of subcooling set.

11. An air conditioning system comprising:

at least one first heat exchanger for heat exchange with room air;

a second heat exchanger for transferring heat from the first heat exchanger to an outside of a refrigerant flow path having the first heat exchanger mounted therein;

a pump for circulating the refrigerant to the first heat exchanger and the second heat exchanger;

a third heat exchanger in a flow path independent both from the first heat exchanger and the second heat exchanger for heat exchange with the second heat exchanger;

a fourth heat exchanger for transferring heat from the third heat exchanger to outdoor air;

a compressor for compressing the refrigerant and circulating the refrigerant to the third heat exchanger and the fourth heat exchanger;

a plurality of temperature sensors for measuring temperatures of the refrigerant flowing in the first heat exchanger; and

at least one flow rate control valve for controlling a flow rate of the refrigerant flowing in the first heat exchanger according to temperatures measured at the temperature sensors.

12. The system as claimed in claim 11, wherein the temperature sensors are provided at a refrigerant inlet end and a refrigerant outlet end of the first heat exchanger, and at a predetermined portion between the refrigerant inlet end and the refrigerant outlet end, respectively.

13. The system as claimed in claim 11, wherein the temperature sensor provided at a predetermined portion between the refrigerant inlet end and the refrigerant outlet end measures a saturation temperature of the refrigerant flowing in the first heat exchanger.

14. The system as claimed in claim 11, wherein the flow rate control valves are provided to a refrigerant inlet end and a refrigerant outlet end of the indoor heat exchanger.

15. The system as claimed in claim 14, wherein, at the time of controlling a refrigerant flow rate, an opening of the flow rate control valve at the refrigerant inlet end of the first heat exchanger is adjusted, and an opening of the flow rate control valve at the refrigerant outlet end is opened to the maximum.

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